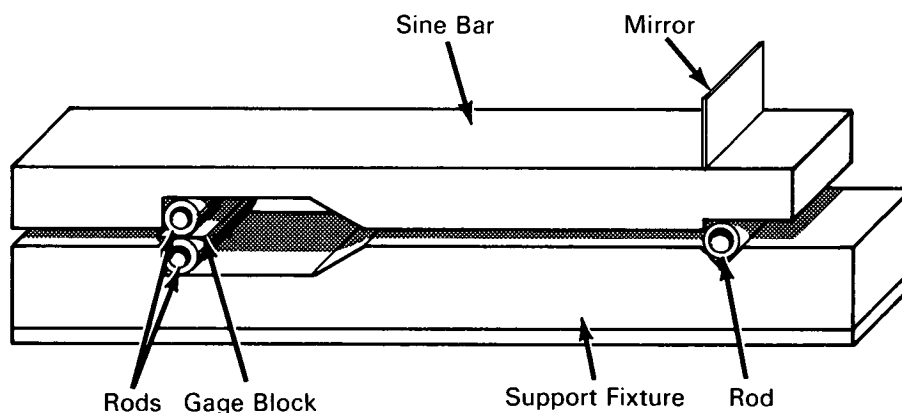


NASA TECH BRIEF



NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Modified Sine Bar Device Measures Small Angles with High Accuracy



The principle of the sine bar has been adapted to the calibration of precision optical autocollimators. In this application, it was required to measure angles over a range of 1.00 arc-second in increments of 0.05 arc-second, with a maximum error of ± 0.01 arc-second in any given increment.

The required measurement accuracy over this extremely small angular range was achieved with the sine bar device shown in the drawing. In this design, the sine bar is a massive bar of steel supported on a fixture by two cylindrical rods near the left end and by one cylindrical rod in a V-groove near the right end. By placing precision gage blocks between the rods on the left end, the sine bar may be made to rotate about the cylindrical rod on the right end. The effective length of the sine bar as measured by the distance between the axes of the cylindrical rods at either end is 20.025 inches. A mirror is rigidly fastened to the right end of the sine bar to deflect a beam of light through an angle twice that of the sine bar rotation. The autocollimator to be calibrated is placed in front of the mirror. Angles of the required magnitude and

accuracy can be generated by a set of 20 commercially available gage blocks which are calibrated in increments of 5×10^{-6} inch, and are guaranteed in flatness and thickness to $\pm 10^{-6}$ inch. By replacing a gage block with another in the series, the normal to the mirror rotates in increments of very nearly 0.05 ± 0.01 arc-second.

Use of the two cylindrical rods on the left of the sine bar eliminates one major source of error due to the variable air films between a gage block in contact with plane metal surfaces above and below it. Such an air film might well be of the order of magnitude of the increments in the gage blocks. When a gage block is in position between the cylindrical rods as shown, there are only line contacts with the rods so that the air films are effectively eliminated. The V-groove surface is provided to minimize backward or forward displacement of the sine bar. This groove is lapped to the rod, so that the two surfaces make an 80 percent line contact through a minimum of 3 degrees of rotation. A thumbscrew may be provided on the support fixture close to the left end of the device, to permit

(continued overleaf)

the sine bar to be raised or lowered without lateral displacement.

Note:

Complete details may be obtained from:
Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland 20771
Reference: B68-10322

Patent status:

No patent action is contemplated by NASA.

Source: M. Thekaekara
(GSC-438)